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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/605,513	10/05/2003	Chen Ou	KYCP0011USA	2512

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EXAMINER	
MONDT, JOHANNES P	
ART UNIT	**PAPER NUMBER**
3663	

DATE MAILED: 11/04/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

1Ɏ 6 38

Office Action Summary	Application No.	Applicant(s)
	10/605,513	OU ET AL.
	Examiner	Art Unit
	Johannes P. Mondt	3663

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 October 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-11 and 19-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-11 and 19-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10/03/05 has been entered.

Response to Amendment

Amendment filed 10/03/05 with aforementioned Request for Continued Examination forms the basis for this office action. In said Amendment Applicants substantially amended all previously outstanding claims through substantial amendment of claims 1, 2 and 19, and added new claims 19-21. Claims 12-18 had previously been cancelled. Therefore, claims 1-11 and 19-21 are in the application. Comments on Remarks are included below under "Response to Arguments".

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. ***Claims 1-4, 10-11 and 19-21*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Ming-Jiunn et al (6,078,064) in view of Seaford et al (2003/0201460 A1).

On claims 1 and 19: Ming-Jiunn et al teach (title, abstract, Figure 2 and col. 2, l. 27 – col. 3, l. 52) a nitride based light emitting diode (LED) comprising: a substrate 18 (col. 1, l. 33 and Figure 2), a light emitting stacked structure formed 13/14/15/16 (col. 1, l. 30-41) over the substrate; a nitride based heavily doped GaN or AlGaN or InGaN or InAlGaN (see col. 2, l. 50-60; hence meeting the limitation on material constitution on line 2 of <u>claim 19</u>) contact layer 12A (col. 2, l. 50-55) formed over the light emitting stacked structure; and a transparent conductive oxide layer 11B (col. 2, l. 53-56) formed over the nitride based heavily doped contact layer 12A.(Figure 2).

Ming-Jiunn et al do not necessarily teach the limitation that the heavily doped contact layer 12A to be a "dual dopant" contact layer, i.e., to comprise at least a p-type dopant and an n-type dopant and a material of the p-type dopant being different from a material of the n-type dopant. However, it would have been obvious to include said limitation in view of Seaford et al, who, in a patent on heavily doped semiconductor layers and in particular heavily doped III-V semiconductor layers (see title, abstract, Field of Invention, [0001], and "Background of the Invention", [0002]), - hence analogous art, teach the use of combined dopants, i.e., more than one dopant, to eliminate the detrimental effects created by increasing the dopant concentration of any single impurity beyond the concentration above which said dopant concentration starts having detrimental effects through diffusion (see Seaford et al, [0005]-[0009]), and teach

in particular the doping with both Be (beryllium) and C (carbon) of any heavily doped III-V layer, thus in particular also the GaN layer by Ming-Jiunn et al, which, being a heavily doped contact layer (12A) necessarily requires high dopant concentration (thus also meeting dependent _claim 19_).

Motivation to include the teaching by Seaford et al in the invention by Ming-Jiunn et al immediately derives from the stated avoidance of deleterious diffusion effects on heavily doped III-V compound semiconductor layers by Seaford et al ([0005]-[0009]) that directly applies to the necessarily heavily doped contact layer 12A by Ming-Jiunn et al, said layer serving to provide electrical contact to the Ni/Au electrode (see Ming-Jiunn et al, col. 1, l. 38) so as to reduce the voltage drop across the contact (what is called contact resistance) (col. 2, l. 55-56).

On claim 2: in the combined invention the nitride based contact layer 12A is made of $Al_aIn_bGa_{1-(a+b)}N$ with a, b, and a+b in between 0 and 1 (inclusive end points (col. 2, l. 55-60; any AlGaInN stoichiometric composition can be thus formulated), and the transparent conductive oxide is made of tin-indium-oxide (ITO) (col. 2, l. 30).

On claims 3 and 4: the further limitation as defined by claims 3 and 4 each *fail to further limit the structure as claimed*, as opposed to the method of making of the structure, and hence fail to distinguish over the prior art, given a single layer is claimed. Parenthetically, Seaford et al do teach said nitride based dual dopant contact layer is formed by adding the p-type dopants and n-type dopants together through epitaxial growth (in particular: MBE) (see [0021]-[0022]), thus meeting, in the combined invention, claim 3.

On claim 10 and 11: Ming-Jiunn et al also teach said substrate to be a conductive (in particular, of first conductivity type) substrate selected out of the group SiC, GaAs and Si, hence meeting claims 10 and 11.

On claims 20 and 21: Ming-Jiunn et al teach (title, abstract, Figure 2 and col. 2, l. 27 – col. 3, l. 52) a nitride based light emitting diode (LED) comprising: a substrate 18 (col. 1, l. 33 and Figure 2), a light emitting stacked structure formed 13/14/15/16 (col. 1, l. 30-41) over the substrate; a nitride based heavily doped GaN or AlGaN or InGaN or InAlGaN (see col. 2, l. 50-60; hence meeting the limitation on material constitution on line 6 of claim 20) contact layer 12A (col. 2, l. 50-55) formed over the light emitting stacked structure; and a transparent conductive oxide layer 11B (col. 2, l. 53-56) formed over the nitride based heavily doped contact layer 12A.(Figure 2).

Ming-Jiunn et al do not necessarily teach the limitation that the heavily doped contact layer 12A to be a "dual dopant" contact layer, i.e., to comprise at least a p-type dopant and an n-type dopant and a material of the p-type dopant being different from a material of the n-type dopant.

However, it would have been obvious to include said limitation in view of Seaford et al, who, in a patent on heavily doped semiconductor layers and in particular heavily doped III-V semiconductor layers (see title, abstract, Field of Invention, [0001], and "Background of the Invention", [0002]), - hence analogous art, teach the use of combined dopants, i.e., more than one dopant, to eliminate the detrimental effects created by increasing the dopant concentration of any single impurity beyond the concentration above which said dopant concentration starts having detrimental effects

through diffusion (see Seaford et al, [0005]-[0009]), and teach in particular the doping with both Be (beryllium) and C (carbon) of any heavily doped III-V layer, thus in particular also the GaN layer by Ming-Jiunn et al, which, being a heavily doped contact layer (12A) necessarily requires high dopant concentration; by which material selection of the p-type and n-type dopants the limitation additional to claim 20 in claim 21 isd also met.

Motivation to include the teaching by Seaford et al in the invention by Ming-Jiunn et al immediately derives from the stated avoidance of deleterious diffusion effects on heavily doped III-V compound semiconductor layers by Seaford et al ([0005]-[0009]) that directly applies to the necessarily heavily doped contact layer 12A by Ming-Jiunn et al, said layer serving to provide electrical contact to the Ni/Au electrode (see Ming-Jiunn et al, col. 1, l. 38) so as to reduce the voltage drop across the contact (what is called contact resistance) (col. 2, l. 55-56).

2. ***Claims 5-9*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Ming-Jiunn et al and Seaford et al as applied to claim 1 above, and further in view of Asai et al (6,554,896 B1) and Tanizawa et al (6,657,234 B1).

On claims 5 and 7: the substrate is an insulating substrate (sapphire; see Ming-Jiunn et al, col. 1, l. 32), the light emitting stacked structure comprising: a first conductivity type (n-type) contact layer 16 (col. 2, l. 50-60 and Figure 2) formed over the substrate and made of n-GaN (col. 1, l. 40) (said n-GaN serves to provide contact to electrode 19 and hence is a contact layer (col. 1, l. 40-41)), hence meeting the limitation

on material constitution in lines 5-6; a light emitting layer 14 (col. 1, l. 35) formed over the first conductivity type nitride based contact layer 16; and a second conductivity type (p-type) contact layer 12 (col. 2, l. 50-60) formed over the light emitting layer 14 and made of AlInGaN and hence meeting the material constitution claimed in lines 10-11 of claim 5.

Ming-Jiunn et al do not necessarily teach (a) a buffer layer formed over said insulating substrate; nor (b) that the light emitting layer is a multiple quantum well.

However, ad (a) it would have been obvious to include the limitation on buffer layer in view of Asai et al, who teach to insert a buffer layer 13 between a sapphire substrate 11 and a AlGaInN layer 42 (end points of the stoichiometric parameters including the binary compounds) of a light emitting stack structure of a light emitting diode so as to improve crystallinity (col. 2, l. 56-59). *Motivation* to include the teaching by Asai et al in this regard is the lattice mismatch between sapphire substrate 18 and n-GaN contact layer 16 also existing in Ming-Jiunn et al while improving crystallinity leads to improved light efficiency because crystal defects absorb light.

Furthermore, ad (b), it would have been obvious to include the limitation on multiple quantum well light emitting layer in view of Tanizawa et al, who, in a patent on a nitride based light emitting diode (LED), hence analogous art, teaches for the specific purpose of lowering operational voltage and increasing emitting output (abstract) that the multiple quantum well has r (e.g., 15 (Example 1)) InGaN quantum wells and (r+1) InGaN barriers, each InGaN quantum well sandwiched in between two InGaN barriers (col. 7, l. 1-14 and col. 14, l. 19-28, i.e., claim 5 in Tanizawa), each InGaN quantum well

fabricated by $In_eGa_{1-e}N$ and each InGaN barrier is made of $In_fGa_{1-f}N$, $r \geq 1$, and $0 \leq f < e \leq 1$ (in particular in Example 1: e=0.3 and f=0; see, however, also the other examples, col. 3, l. 50-55 and col. 4, l. 59-65) for other values of these parameters). Thereby, claim 7 is also seen to be met..

Motivation to include the teaching by Tanizawa in the invention by Ming-Jiunn et al derives from the knowledge common in the semiconductor light emitting diode art that it takes two barriers to define a well: see, e.g., M. Fukuda, "Optical Semiconductor Devices", Wily Series in Microwave and Optical Engineering, John Wiley and Sons, New York (1999), pages 82-85.

On claim 6: the insulating substrate is made of sapphire (col. 1, l. 32 and Figure 2).

On claim 8: the LED by Ming-Jiunn et al further comprises a first conductivity type (n-type) cladding layer 15 (col. 1, l. 35 and Figure 2) interposed between the first conductivity type contact layer 16 and the multiple quantum well light emitting layer 14, and the first conductivity type cladding layer is made of AlGaN hence the limitation on material constitution in line 4 of claim 8 is also met.

On claim 9: the LED by Ming-Jiunn et al further comprises a second conductivity type cladding layer 13 (col. 1, l. 35 and Figure 2) interposed between the second conductivity type contact layer 12 and the multiple quantum well light emitting layer 14 and made of AlGaN (loc.cit.), hence the limitation on material constitution in line 4 of claim 9 is also met.

Response to Arguments

Applicant's arguments filed 10/3/05 have been fully considered but they are not persuasive. In particular, while the substantial amendment to claim 2 constitutes a substantial broadening of the claim limitation through inclusion of the end points of the stoichiometric parametric range, thus enabling in principle a rejection of several claims over Kneissl as cited, an update search has revealed Seaford et al. teaching the selection of dual dopant layers for any heavily doped semiconductor layer so as to avoid diffusion due to too much concentration of any single dopant. Because semiconductor contact layers are necessarily heavily doped because of their purpose to reduce contact resistance the present application with the current claim language is held substantially unpatentable over Ming-Jiunn et al in view of Seaford et al, with reference to the art rejections provided overleaf.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure: Kneissl et al (6,515,308 B1), particularly claims 1-4 and 19-21, in view of Seaford et al (for separate p-type and n-type dopant materials).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P. Mondt whose telephone number is 571-272-1919. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack W. Keith can be reached on 571-272-6878. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JPM
October 29, 2005

Patent Examiner:

Johannes Mondt (Art Unit: 3663).